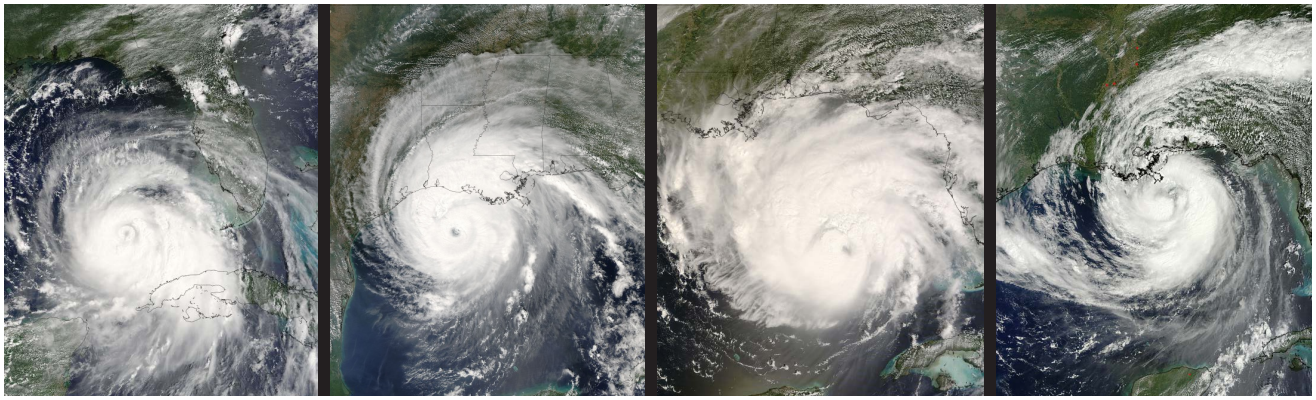
Edge Conditions and the Centrality of Architecture: Emerging Technologies, Multi-disciplinarity and Design Responses to Challenges Facing the Texas – Louisiana Gulf Coast

Jeffrey Carney
Louisiana State University

Thomas Colbert
University of Houston

A succession of disastrous storms, Katrina, Rita, Ike, and Gustav made it clear that profoundly important issues related to urban and coastal protection, resilience, and sustainability were not being adequately addressed along the Gulf Coast.

No government structure had been put in place to plan for or adequately respond to these disasters. After each of these events, new sets of previously unanticipated failures of planning and design came to light. Shockingly, with billions of dollars and many lives lost, each time a hurricane struck it was clear that the consequences could have been much worse if storm trajectories or size had been a little different. Climate research is also showing that these storms are not flukes. The onslaught of extreme weather events is not the exception but the new normal for the upper Gulf Coast. In response to these events, multi-disciplinary science, engineering, and design organizations have come together in impacted regions with designers acting as key participants. The new "design advocacy" that this positioning encourages is based on the synthetic nature of design, its inherent multi-disciplinarity, and the visual communication skills and speculative skills of the designer. These qualities are central to addressing resiliency and regional design issues that for generations have been considered the realm of engineering or public policy alone. The role of design in these emerging organizations has the potential to transform the design professions. It challenges schools of architecture and design to reexamine design studio structures and the range of disciplines associated with design education.



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BACKGROUND

Following repeated assaults on our coastlines, local, state, and federal agencies were not able to develop a broad or cohesive view of the nature of the risks posed by severe weather events or ways of addressing them. Individual agencies responded on a piecemeal basis according to mandates that were largely associated with the traditional roles and responsibilities of individual professions and disciplines. Generations of focus on specialization had built silos between governmental agencies, offices, and disciplines that precluded the development of a shared vision. The Army Corps of Engineers (USACE) looked at levees as isolated civil engineering structures while ecologists saw wetlands as purely ecological systems. Climate scientists debated each other in scientific journals while surge tide modelers worked to inform state evacuation planning. None of these activities were being coordinated or applied to planning, architectural, or regional design decision-making. Public policy and disciplinary silos seriously hampered disaster response and proactive planning.

At the time of Hurricane Katrina no governmental agencies were tasked with providing overall planning for disasters of this sort, or with planning for climate change or for the emerging confrontation between urban growth, industrial expansion, and ecosystems degradation which coastal regions are faced with. FEMA and the USACE, representing an ascendant political culture of deregulation and limited government, appeared to be unable to grasp the scale and complexity of the challenges they faced.

As a result of the obvious need for resiliency planning and the failure of government to provide it, groups of concerned citizens, professional and academic experts, and NGO's from all over the Gulf Coast began to come together to address these challenges. They came together with the hope and expectation of formulating comprehensive, practical plans for the future of their regions and to work toward the implementation of these plans. To those who came together to think through these issues it was immediately clear that the problems facing the Gulf Coast, its people, its economies, and its ecosystems, were multi-disciplinary. They were global and regional, and yet at the same time local. The challenge they faced was to break down silos and create forward thinking, robustly informed plans for the future of the upper Gulf Coast.

Among the many teams that were created to respond to unique challenges facing their coastal regions the LSU Coastal Sustainability Studio (CSS) in Louisiana and the SSPEED Center in Texas each brought together substantial multi-disciplinary teams of university based and professional researchers to plan

Figure 1: Gulf Coast Storms: Katrina, Rita, Gustav, and Ike devestated the Gulf Coast between 2005-2008

for the future. In each of these organizations, design is informed by and serves as a test bed for research and at the same time, in an organic melding of scientific method and design process, designers are involved in setting the direction of research efforts. In each of these teams, designers work with scientists and a broad range of professionals to lay out a range of rational alternative futures, scenarios for local communities and government agencies to choose from or amend, with the ultimate aim of adopting well informed design and planning proposals into law. In two neighboring states facing similar challenges, independently funded multi-disciplinary research/planning/planning advocacy teams came together to address the future of the upper Gulf Coast. In so doing they are creating new roles and opportunities for design practice and education.

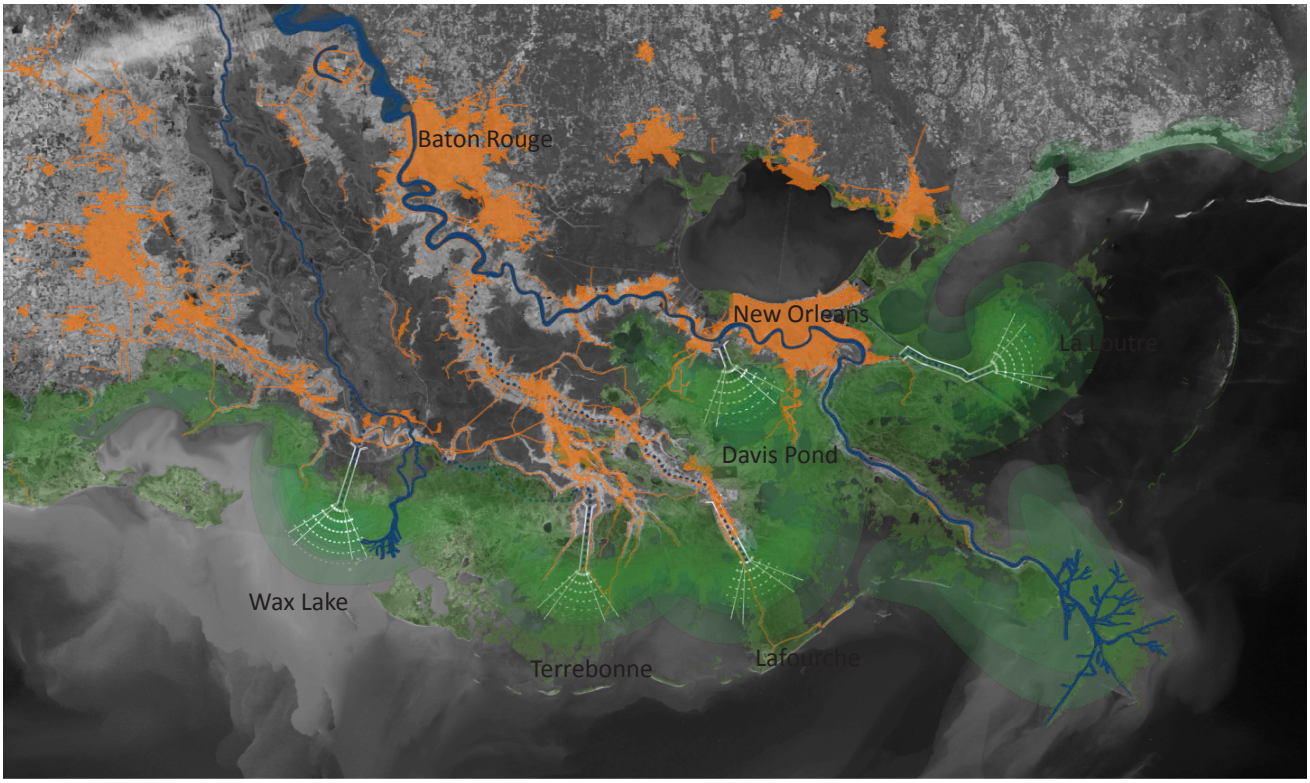
While the CSS and the SSPEED Center are different in many respects, they share the same common goals and aspirations with respect to the role of designers as integral partners in research. In both teams, researchers are paid for their efforts, whether they come from the professional or academic worlds. Students, where involved, are employed on a salary basis. While aspects of the research and core design problems are taken up by advanced design studios, these student projects are treated as teaching exercises rather than as funded research. In both teams similar specializations and disciplines are represented: climatology, meteorology, geo-sciences, ecology, civil and environmental engineering and hydrology, ADCIRC and other floodwater modeling, economics, law, public policy, and design including architecture, landscape architecture and planning. In both cases designers work with their teams to identify risks. Design responses are then prepared to meet those risks. These projective designs are then tested scientifically and in the laboratory of the political arena.

THE COASTAL SUSTAINABILITY STUDIO (CSS)

In Louisiana, the effects of Hurricane Katrina were dramatic and immediate. Over 1,000 people died in the storm and 10's of thousands were displaced and left homeless. The storm was a true wakeup call to a state that had long ignored its failing infrastructure, declining environmental systems, unplanned communities, and vulnerable populations. Across the state and nation there was an outpouring of support through government, volunteers, industry groups, NGO's, and University based initiatives. The "Louisiana Speaks" planning process was formed through a partnership of state agency, university interests, and private groups. For eighteen months this effort gathered citizens, planners, designers, engineers, and scientists to develop a bold vision for coastal Louisiana.

As Louisiana Speaks drew to a close in 2007 it became clear that the legacy of planning started by this effort was in peril. At that time an initiative to restart the defunct state office of planning was turned down by Governor Jindal. The Coastal Protection and Restoration Authority (CPRA) had completed the 2007 state restoration master plan and was building up to its 2012 plan but design and urban/regional planning had been left out of this mix and a return to the "silos" of the past seemed imminent.

In response to the lack of integration across disciplines the Coastal Sustainability Studio (CSS) was initially conceived of by a group of interdisciplinary LSU faculty under the leadership of Dr. Robert Twilley of the Department of Oceanography and Coastal Sciences. Initially proposed as



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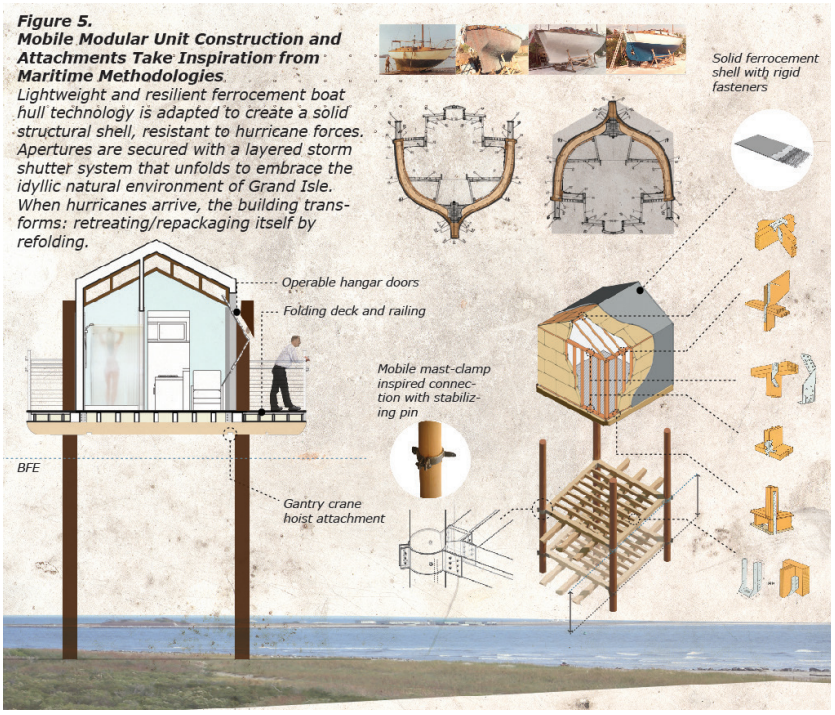
an Integrate Graduate Research and Technology Traineeship (IGERT) grant through the National Science Foundation, the initiative was eventually funded privately through corporate and NGO support. The group started operation in the fall of 2009.

The goal of the CSS is to design sustainable ecological, human, social, and infrastructural systems that reduce vulnerability associated with diverse scenarios of coastal hazards, habitat degradation, and global environmental change. The environmental and economic issues in coastal Louisiana - estimating ecosystem response to restoration and community protection, designing more resilient coupled natural-social systems, and promoting infrastructure for energy and navigation - mirror similar concerns in major river delta regions worldwide. These challenges provide a laboratory to develop new designs that reduce risks to social, economic, and natural resources, with a sound basis for policy decisions that focus on adaptation through more sustainable regional and land-use planning.

The studio operates as a space where specialists can engage the larger, more complex issues of the delta that overwhelm individual disciplines. The studio is located in the College of Art and Design but it is not a department itself or the property of any one discipline. It operates as a resource for the university community and communities across the state, enabling complex problems to be supported by faculty not normally accustomed to working in a multi-disciplinary design focused setting.

The CSS is led by a director from the School of Architecture, an associate director from the Department of Climate Science and an "executive committee" of faculty from Civil Engineering, Coastal Science, Architecture, and Landscape Architecture. The role of this group is to build connections between a diverse

Figure 2: Sediment Diversions move river water, silt, and silt in pulses from the Mississippi River to build land in the Delta.



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range of projects in the CSS and faculty throughout the university. In four years the CSS has brought together over forty faculty members from twenty different departments to work on a wide range of coastal projects. Faculty members working on CSS projects are provided funds to hire graduate assistants, recent graduates, and post graduate research associates to work collaboratively in the CSS studio space. Working under the direction of research associates and faculty, the CSS employs between fifteen and twenty graduate students from a range of different departments.

The first year of the studio's operation focused on a project bringing urban designers and landscape architects together with coastal scientists, and civil engineers to examine the devastated New Orleans 9th Ward. This project engaged rehabilitation of natural ecosystems in and around the New Orleans region. Collaboration at this scale was new to everyone at the table. During this first year the CSS was invited to the 2010 Venice Biennale to partner with a team from Princeton University on a project called "In the Mississippi Delta: Constructing with Water". The biennale was an opportunity to turn the corner from what had started as essentially a traditional practice model based on design and planning with scientists and engineers filling a consultant role to something more inclusive and transformative for all of the disciplines involved. The disciplinary differences that appeared during initial work in the 9th ward were predictable and reinforced the traditional boundaries of our fields. However, the shifting focus of the work to rebuilding the delta by using the power of the Mississippi River had thematic meaning to each of the disciplines. The dynamics of river and sediment, the design of "smart" infrastructure to bend but not break the river to our needs, and the design of communities that could adapt to the opportunities provided by this landscape were conceived as interdependent trans-disciplinary concepts. Issues of dynamics, flexibility, and change allowed the disciplinary boundaries to give way for true interaction around ideas.

Figure 3: Design for resilient and adaptable housing for coastal conditions. (Sattler 2012)

Continuing the theme of building in the dynamic Louisiana delta environment we have developed partnerships with a number of corporations, NGO's, government agencies, and other academic institutions across the Gulf Coast for a number of projects. We currently support a number of funded design, research, and outreach projects. Currently we are invested in work ranging from the development of coastally "insurable" housing technologies to research into community responses to an increasingly volatile oyster industry, and the development of a course about restoration and design communication in the journalism school. We will be running a session of the Mayor's Institute on City Design in the fall focused on issues of resilience. Ongoing external grants currently focus on the HUD funded Louisiana Resiliency Assistance Program that is developing best practices from ongoing coastal planning efforts as well the NEA funded "mobile museum" which is collecting data and building an exhibition of cultural adaptation techniques in coastal Lafourche Parish. Through an ever expanding network of faculty within LSU and strong connections with external researchers, institutions, state and federal agencies, the CSS continued to build on the issues that coastal Louisiana faces.

THE SEVERE STORM PREDICTION, EDUCATION, AND EVACUATION FROM DISASTERS (SSPEED) CENTER

Following the inundation of New Orleans by hurricane Katrina in August of 2005 and the subsequent arrival in Texas of tens of thousands of Katrina refugees, Houstonians appeared unfazed by the disaster. Houston is on higher ground it was argued, and Texas is sure to be better prepared than Louisiana. But when hurricane Rita approached a month later packing one hundred and eighty mile per hour winds, the appearance of sanguinity was ruptured. Houstonians rushed to evacuate in what became the largest and most disastrous evacuation in U.S. history. Hundreds of thousands of motorists were left stranded without water or gasoline as the regional roadway network was transformed into a vast spider-web shaped parking lot. Over a hundred people died in the evacuation. Fortunately for Houston, at the last minute Rita's winds dropped and her trajectory veered to the east. Western Louisiana took the brunt of the storm, but it was clear that Houston had dodged a bullet for which it was no better prepared than New Orleans had been.

In December of 2005, Prof. Phil Bedient of Rice University's Department of Civil and Environmental engineering held a hastily scheduled conference to examine the implications of these events for the upper Texas Gulf Coast. This conference included presentations by experts from five major research universities, and government officials. The speakers laid out many of the issues to be addressed in developing a comprehensive response to the threat of extreme weather events. From the very beginning it was clear that the expertise that was necessary to deal with events of this kind went far beyond the confines of isolated institutions and individual disciplines. It required unprecedented teamwork. It was at a dinner following that conference that the SSPEED Center was first proposed.

Formally established in 2007, the SSPEED Center received limited funding, initially to provide disaster preparedness training. The Center's development was spurred on when Hurricane Ike struck Galveston Island in 2008. Ike caused thirty billion dollars in damages and took approximately two hundred lives. As disastrous as this was, to the recently assembled planning and research team it

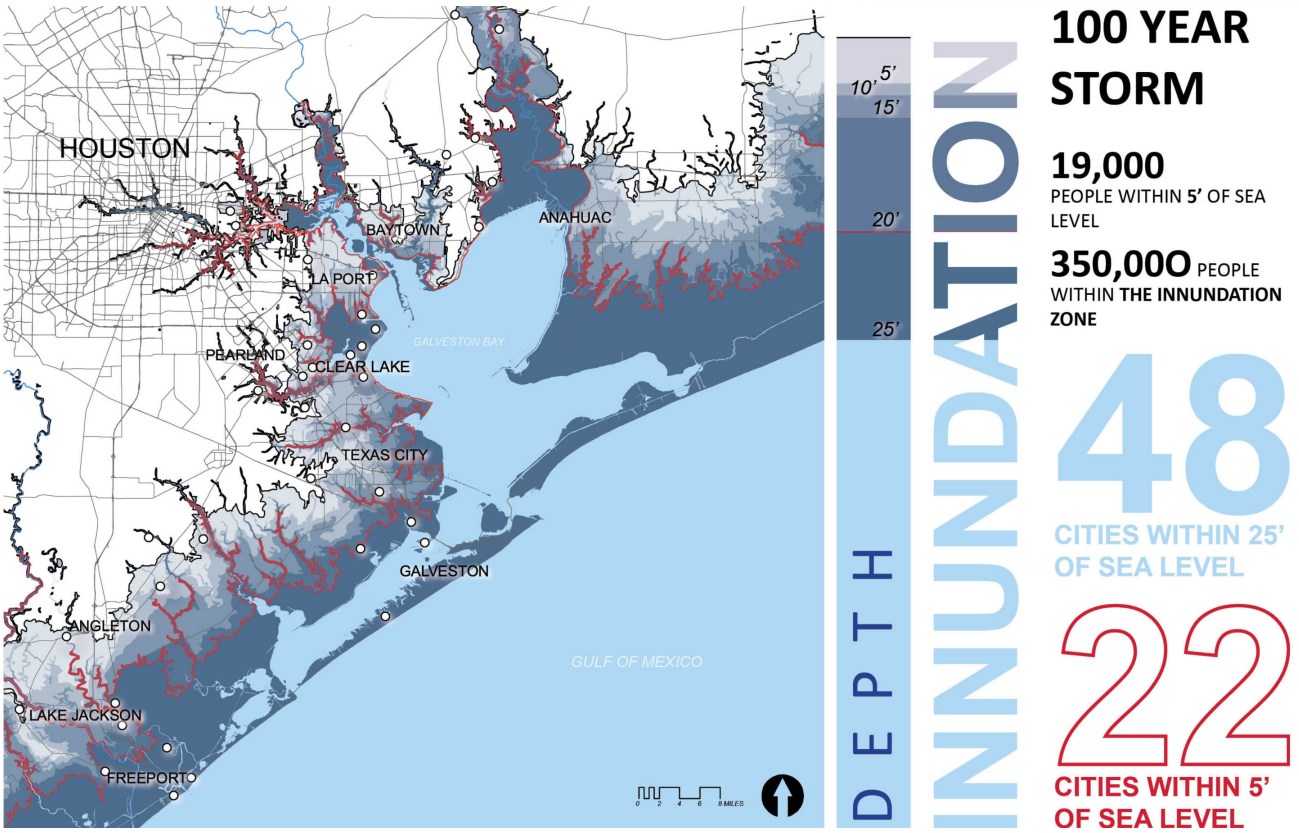

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Figure 4: Map showing inundation risks from a 100 year storm.

was instantly apparent that damage would have been much worse if the storm had hit a few miles to the west of its ultimate landfall, or if it had been a more powerful storm. It was shortly after Hurricane Ike that the Center received its first major funding in the form of grant from the Houston Endowment. As a result of this grant, the team was expanded and it became possible for the Center to fund research projects for the first time.

Although it has resulted in numerous publications and conferences, the SSPEED Center was not formed for purely academic purposes. It was intended to facilitate planning and design work that could reduce vulnerability to hurricanes and tropical storms. For this reason, from the beginning design and planning were centrally involved the center's research work. Economic, structural and social vulnerability assessments were guided by land use evaluation, transportation planning, and site analyses. Proposed responses to these vulnerabilities centered on design adaptations of building and infrastructure and land use planning strategies, as well as the design and arrangement of new structural defenses. Each of these responses was developed based on trans-disciplinary research provided by experts in historically isolated fields. Surge tide modelers and climatologists worked with designers and other scientists to establish the probability of severe weather events, potential inundation levels and anticipated sea level rise. Proposed levee and evacuation roadway construction and local design responses were developed in discussions between planning and design specialists, civil engineers, hydrologists and ecologists. Coastal scientists and naturalists worked with surge tide modelers, economists, recreational planners, public policy, planning, and design experts. Design and planning proposals that rose to the top were tested against possible rainwater and surge flooding. Potential economic and environmental damage assessments were

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balanced against defense construction costs and the potential value of proposed economic development strategies. The range of expertise included in these efforts was bounded by relevance to the issues at hand rather than by institutional or disciplinary limits.

Since its inception in 2005, the Center was conceived of as small "bottom-up" organization. With funding from the SSPEED Center, research team members define their research in informal discussion with the Director, the Co-Director and other team members. There is no board or higher-level administrative oversight committee. The team meets regularly to allow members to present their work to each other for review and discussion. Formal, public presentations occur at annual conferences. Leading researchers from around the world are invited to present their work and discuss the progress of the SSPEED team at these events. This "bottom-up" organization has enabled a high degree of independence in the pursuit of creative engagement between disciplines and flexibility in the development independent research agendas.

The Center has developed a flexible concept for making the upper Texas Gulf Coast safer and more sustainable while providing enhanced recreational and economic development opportunities. This concept includes a menu of design and planning alternatives for local communities and state agencies to evaluate and choose from and to serve as starting points for more detailed studies. This concept and the menu of alternatives contained within it are a direct reflection of the inclusiveness of the design team, the range of its scientific and technical expertise, and the central involvement of designers in the process.

Figure 5: Gate structure design for hurricane closure

The coastal resilience-planning concept proposed by the SSPEED Center is a layered defense system. It advocates avoiding building in the most dangerous areas as well as preserving and restoring wetlands, dunes and other natural features that exist there and that can provide resilience and protect habitat. Economic development proposals have been prepared to increase income to land owners based on coordinated recreational uses and the creation of an ecosystem services marketplace. In other areas buildings and infrastructure should be designed to resist the destructive forces that they might be subject to while avoiding negative ecological impacts. In areas that are already densely developed or that contain critical national infrastructure, local structural defenses are proposed. These structures are seen as multi-functional infrastructure that not only provide protection but also enhance the communities and natural systems that they are to be situated in. Structural defenses are designed to be affordable and to accommodate sea level rise.

The ability of the SSPEED Center to bring together expertise and experience in a broad range of academic and professional disciplines, and to coordinate a multi-institutional team of researchers is a direct result of the sense of urgency and common purpose created by a succession of coastal storms. In a clear case of necessity as the mother of invention, a new model of design practice has emerged in Texas. This model articulates the importance of design in the fields of research, coastal planning, and climate change adaptation.

CONCLUSION

New organizational structures are essential to deal with the complex multi-scalar, multi-disciplinary challenges of climate adaptation and regional design, particularly in coastal areas. Design is at the center of emerging university based applied research programs that are responding to these challenges because design is fundamentally synthetic, it is focused on communication, and it is projective and aspirational by nature. Design is about making plans for the future and working toward the implementation of those plans. For these reasons designers have always worked at the center of multi-disciplinary teams.

Trans-disciplinary thinking provides a space where emergent challenges can be met and where design thinking finds a natural home. Architecture school often challenges us to engage outside our field by inviting "clients" or consulting with experts for particular aspects of projects. Both reinforce traditional architectural working relationships. Truly trans-disciplinary projects force the architect to expand the discipline from the strict limitations of the individual building. They create the opportunity to address buildings as part of the urban/ecological/social system and to think of design as an integrated art, from the scale of regional design to the scale of the design of individual building components. As architects gain voice in ecological, planning, and landscape scale work, we are able to broaden the relevance of the discipline and directly engage major issues facing the future of the built environment. In an era of deregulation and government stand-down in relation to so many critical planning needs we are also able to represent local communities and individuals that are otherwise isolated in a vast network of global forces (natural, economic, social, political). We can and should represent these forces to local communities and decision makers, and advocate for rational planning and design at all scales.

For schools of architecture and other design disciplines there are a number of advantages to the development of organizations of this sort and the

multi-disciplinary approach that they represent. They bring with them applied research opportunities that are rare in design schools. More rare yet are broad based research teams in which design is seen as a full partner in work that is broadly regarded as relevant to the most important problems facing the society today. At a time when architecture is challenged by popular confusion about its significance as a profession and especially with regard to its significance to public policy matters this is an important issue. Also of benefit are opportunities to work closely with historically distant disciplines and with design disciplines that we have only recently become disengaged from: planning, urban design, and landscape architecture. Building new linkages enriches design disciplines intellectually by bringing in new and unprecedented data sets, methods of reasoning, operational models and disciplinary traditions. Broadening the reach of design and unifying the design professions creates new relevance and new opportunities for the discipline and for practice.

It is not clear that the work of research centers of this sort can be directly integrated into architecture curricula, especially design curricula. This is a problem for all funded research efforts. The need to ensure rigorous results isn't easily reconciled with the need to encourage creative exploration. However, the development of research centers and multi-disciplinary teams of this sort suggests the possibility of fundamentally multi-disciplinary studios with students and faculty from multiple departments. It also suggests the importance of entirely new electives and required courses in degree plans of the future. Background in ecology, geosciences & hydrology, climate science and GIS courses can be seen as being as relevant to the training of architects as training in electrical, plumbing and mechanical systems or Revit and Photoshop. Regional design and its essential collaboration with the sciences can be seen as being as important as furniture and building component design to the full understanding of the design of the built environment.

The history of architecture is a history of integration of new disciplines and new technologies into the discipline. This is not a new challenge. But the nature and range of disciplines that are required to deal with design for changing climates is new. If we are to take the challenge of design for ourselves and for future generations seriously, schools of architecture will need to embrace opportunities created by the breadth and complexity of the challenge. In so far as this involves the development of multi-disciplinary research and design collaboration, the work of teams that are already engaged in this effort should be of interest.

The techniques and methods that are being developed through the research of multi-disciplinary design research teams ranges from the development of new scientific and public engagement practices, to engagement with dramatically different modeling software. As we look to and design for changing environments and increased risk, these techniques will play an ever-larger role in design for social, ecological, and cultural development. We now understand that we have to operate under the assumption of a changing climate and a changing world. This challenges the discipline of architecture to operate in the world in a new way. It challenges schools of architecture to embrace a more multi-disciplinary worldview.